APPEAL BRIEF UNDER 37 C.F.R. § 41.37

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Kevin Torek et al.	Examiner: Tu-Tu V. Ho
Serial No.: 10/789,800	Group Art Unit: 2818
Filed: February 27, 2004	Docket: 303.871US1

For: SEMICONDUCTOR FABRICATION THAT INCLUDES SURFACE TENSION CONTROL

APPEAL BRIEF UNDER 37 CFR § 41.37

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Appeal Brief is presented in support of the Notice of Appeal to the Board of Patent Appeals and Interferences, dated on August 17, 2006, from the final Rejection of claims 1-2, 4-45 of the above-identified application, as set forth in the final Office action dated on 19 April 2006.

The Commissioner of Patents and Trademarks is hereby authorized to charge Deposit Account No. 19-0743 in the amount of $500.00 which represents the requisite fee set forth in 37 C.F.R. § 41.20(b)(2). The Appellants respectfully requests consideration and reversal of the Examiner's rejections of pending claims.

1. REAL PARTY IN INTEREST

The real party in interest of the above-captioned patent application is the assignee, Micron Technology, Inc., a Delaware corporation doing business at 8000 South Federal Way, Boise, Idaho 83716-9632.

2. RELATED APPEALS AND INTERFERENCES

A Notice of Appeal to the Board of Patent Appeals and Interferences was filed on August 17, 2006, from the final Rejection of claims 1-2 and 4-45 of U.S. Patent Application Serial No. 10/789,800, as set forth in the Final Office Action dated on 19 April 2006. There are no other related appeals and interferences.

3. STATUS OF THE CLAIMS

The present application was filed on 27 February 2004 with claims 1-95. An Office Action was mailed on 9 June 2005 containing a restriction requirement. A response to the restriction requirement was filed on 11 July 2005 electing, without traverse, claims 1-45. A non-final Office Action was mailed on 7 September 2005 rejecting claims 1-45. A response was filed 23 January 2006 with claims 1-2, 4-45 pending; claim 3 was cancelled, claims 1-2, 4-16, 18-21, 23-30, 32-40 and 42-45 were amended, and claims 17, 22, 31 and 41 were in the condition originally filed. A final Office Action was mailed on 19 April 2006 rejecting claims 1-2 and 4-45 for the second time. Claims 1-2 and 4-45 are in the condition as filed on 23 January 2006. Claims 1-2 and 4-45 remained pending U.S. Patent Application Serial No. 10/789,800 and are the subject of the present Appeal.

4. STATUS OF AMENDMENTS

No amendments have been made subsequent to the Office Action response filed on 23 January 2006.

5. SUMMARY OF CLAIMED SUBJECT MATTER

The reader is directed to the amended specification filed on January 23, 2006 when referring to the page and line numbers used herein.

As noted in the Background section of the specification (at pg. 2, lines 13-28), a memory cell capacitor may utilize a "container" structure because it promotes an efficient use of semiconductor die real estate. Such a memory container will have dimensions that are taller than they are wide (i.e., a high aspect-ratio). A high aspect-ratio container capacitor can allow more energy to be stored while maintaining the same two-dimensional surface area. However, due to the close proximity of adjacent memory containers, surface tension caused by liquid capillary forces during wet etching may cause the container structures to lean and/or stick together.

To address this problem Appellants describe surface tension control methods to prevent leaning and sticking of memory container structures. The methods taught by Appellants, and claimed in claims 1-2, 4-45, use a surface tension lowering agent for etching layers adjacent to the side walls of the memory container. (pg. 3, lines 12-17; Figs. 1, 3, 4).

INDEPENDENT CLAIM 1

Claim 1 relates to a method of etching a layer adjacent to a memory container using a vapor that includes a surface tension lowering agent. Support is found on pg. 3, lines 13-17; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 7

Claim 7 relates to a method of etching a layer adjacent to a memory container using a vapor that reduces surface tension that includes methanol. Support is found on pg. 3, lines 13-17; pg. 6, lines 13-16; pg. 10, line 16; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 11

Claim 11 is a method related to etching a layer adjacent to a capacitor container with a vapor that includes hydrogen fluoride, an etch initiator composition and an alcohol. Support is found on pg. 3, lines 19-23; Figs. 1, 3, 4.

INDEPENDENT CLAIM 16

Claim 16 is an integrated circuit fabricating method comprising chamber vapor phase etching an insulator layer adjacent to a capacitor container with a vapor that includes hydrogen fluoride and isopropyl alcohol. Support is found on pg. 3, lines 24-29; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 21

Claim 21 relates to a method of vapor phase etching an insulator layer adjacent to the side wall of a memory container associated with an array of memory in a chamber using a mixture of hydrogen fluoride and isopropyl alcohol. Support is found on pg. 4, lines 1-7; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 26

Claim 26 relates to a fabrication method comprising vapor phase etching an insulator material adjacent to a side wall of a memory container using a vapor mixture comprising an etch initiator composition, hydrogen fluoride and alcohol. Support is found on pg. 4, lines 8-16; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 31

Claim 31 relates to a method of vapor phase etching an insulator adjacent to a double-sided container using a vapor that includes an H_2O vapor, an HF gas and a surface tension lowering agent. Support is found on pg. 4, lines 17-22; pg. 6, lines 17-21; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 38

Claim 31 relates to a fabrication method comprising forming a memory container in a borophosphosilicate glass and removing at least a part of the BPSG material using a vapor wet etch operation with a vapor that includes a surface tension lowering agent comprising hydrogen fluoride and alcohol. Support is found on pg. 4, lines 23-28; pg. 6, lines 6-12; pg. 10, line 14; and Figs. 1, 3, 4.

INDEPENDENT CLAIM 41

Claim 41 is a method related to forming a memory container in an oxide that includes a double-sided capacitor using a vapor comprised of hydrogen fluoride, an etch initiator composition and a surface tension lowering agent. Support is found on pg. 4, line 29-pg. 5, line 3; pg. 9, lines 28-30; and Figs. 1, 3, 4.

This summary does not provide an exhaustive or exclusive view of the present subject matter, and Appellant refers to the appended claims and its legal equivalents for a complete statement of the invention.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-2 and 4-37 are unpatentable under 35 U.S.C. § 103(a) over Shin et al (U.S. 6,385,020) in view of Verhaverbeke et al (U.S. 5,922,624).

2. Whether claims 38-45 are unpatentable under 35 U.S.C. § 103(a) over Shin et al (U.S. 6,385,020) in view of Yang et al. (U.S. 6,727,155).

7. ARGUMENT

A.) The Applicable Law under 35 U.S.C. §103(a)

35 U.S.C. § 103 states:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The Examiner has the burden under 35 U.S.C. § 103 to establish a *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). To do that the Examiner must show that some objective teaching in the prior art or some knowledge generally available to one of ordinary skill in the art would lead an individual to combine the relevant teaching of the references. *Id.*

The *Fine* court stated that:

> Obviousness is tested by "what the combined teaching of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 878 (CCPA 1981)). But it "cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination." *ACS Hosp. Sys.*, 732 F.2d at 1577, 221 USPQ at 933. And "teachings of references can be combined *only* if there is some suggestion or incentive to do so." *Id.* (emphasis in original).

The M.P.E.P. adopts this line of reasoning, stating that

> In order for the Examiner to establish a *prima facie* case of obviousness, three base criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Appellant's disclosure.

M.P.E.P. § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991)).

In addition, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in Appellant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991); MPEP § 2143. Finally, the Examiner must avoid hindsight. *In re Bond*, 910 F.2d 831, 834, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990).

B.) Establishing Inherency under M.P.E.P § 2112

Inherency may be relied upon for a rejection of claims under 35 U.S.C. § 103; however, the M.P.E.P. guidelines state:

> In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." (emphasis in original)

M.P.E.P. § 2112 (citing *Ex parte Levy,* 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)).

Moreover, "the fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." *In re Rijckaert* 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993). (emphasis in original) *M.P.E.P.* § 2112.

Finally, to establish inherency the M.P.E.P states:

> [T]he extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so *recognized by persons of ordinary skill.* Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.' (emphasis added)

M.P.E.P § 2112 (citing *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999).

C.) The Meaning of "Process" under 35 U.S.C. § 101

35 U.S.C 101 states:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title [35 USC § §1 et seq.].

"The term 'process' as defined in 35 U.S.C. 100, means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." *M.P.E.P.* § 706.03(a) (emphasis added)

D.) Discussion of the Advisory Action.

The Advisory Action dated 7 July 2006 stated, among other things, that Appellants' disclosure lacked a clear and deliberate definition for "surface tension lowering". Appellants disagree because surface tension is a commonly used term in the physical sciences with definite meaning.

1.) Appellants' claimed inventions are not defined by the language used in the Advisory action, but by the language of Appellants' claims.

Alleging no clear definition for surface tension lowering, the Advisory Action excluded the every day common meaning and introduced an extreme limitation, which was attributed to Appellants and to Verhaverbeke et al (5,922,624), but which is not found in either Appellants' or Verhaverbeke's disclosures. More specifically, with respect to the definition of surface tension lowering, the Advisory action stated

> As such, according to the prior art of record including the present application, surface-tension related is recognized only in the liquid-phase etching (present invention, paragraph [0006] . . . . (emphasis added)

Appellant made no such statement in para. 0006. Appellant is unaware of any such limitation and submits a reference as support that no such limitation likely exists. (see Exhibit A: "Solid Surface Tension: The Equation of State Approach and the Theory of Surface Tension Components. Theoretical and Conceptual Considerations")

The Advisory action then incorporated the above alleged limited definition for surface tension to construct the following alleged consequence:

> [T]he '624 reference, col. 1, lines 60~67: "in the gas phase the etching of small features is facilitated while surface tension effects hamper this in the liquid phase") and as such, by utilizing vapor phase etching as is disclosed by the '624 reference, including a vapor including a hydrogen fluorine (HF) as a main component and an alcohol, a methanol, and specially carboxylic as additives, *the vapor-phase alcohol, a methanol, and specially carboxylic*, being in the vapor phase per se, functions as a

> surface tension reducing agent, because surface-tension related is recognized only in the liquid-phase etching. (emphasis added)

Appellants find the above position that "being in a vapor phase per se functions as surface tension reducing agent because surface-tension related is recognized only in the liquid-phase" contradictory (emphasis added). Consequently, Appellants are unclear as to what principle is being argued here in the Advisory Action. Even so, Appellants assert:

(a) Verhaverbeke et al do not define "facilitated" to mean anything other than the commonly accepted definition "to make easier";

(b) Surface tension is not recognized only in liquid phase etching; and

(c) Verhaverbeke et al do not disclose any "per se" functionality, let alone surface tension lowering functionality.

Appellants believe that Verhaverbeke et al in col. 1, lines 65-67 are merely stating the obvious-- that surface tension problems make gas phase etching of small features easer than liquid phase etching. Therefore, Appellants object to the above Advisory Action-imposed limitation as being the assertion of a subjective belief, and request Appellants' claims be viewed in light of the language used in the claims.

2.) Appellants' surface tension lowering agent is a new use, and is therefore allowable subject matter under 35 U.S.C. § 101.

The Advisory Action concluded that a surface tension lowering agent is merely the "discovery of a previously unappreciated property or a scientific explanation for the prior art's functioning . . . ." (citing M.P.E.P. § 2112 [R-3]). Appellants respectfully disagree and note that under the guidelines provided in M.P.E.P § 2112, the burden rests with the Examiner to show the new use, new function or unknown property is inherently present in the prior art.

A "property" is a basic or essential attribute shared by a class of things, an "agent" is something that produces a particular effect. "Tension" is a force per unit length, not a property. A surface tension lowering agent is therefore something used to produce lower surface forces per unit length caused, for example, by capillary forces. As support, Appellant stated in the Detailed Description:

> [E]mbodiments of the invention introduce a surface tension lowering agent into the vapor, thereby lowering the surface tension that is resident on the surface of the layer being etched because of the adsorbed layer. Therefore, the adsorbed layer on the surface of the layer being etched may be thicker (in comparison to typical approaches) while lowering the amount of surface tension that maybe present. (pg. 18, lines 1-6).

In contrast, Verhaverbeke et al state "[t]he acetic acid only serves as catalyst." (col. 4, line 34). A catalysts is something that changes the rate of a chemical reaction without itself being net consumed in the reaction. A catalyst is not a surface tension lowering agent. As outlined above in the Summary of Claimed Subject Matter, Appellants disclose and claim methods for using a surface tension lowering agent, not a scientific explanation of a prior art functioning of a catalyst. Therefore, Appellants' surface tension lowering agent is neither a property nor an explanation, but a use that is proper subject matter under 35 U.S.C. § 101.

3.) The Advisory action itself provided sufficient evidence showing the claimed subject matter is not inherently present.

The M.P.E.P. offers the following guidance for determining persons of ordinary skill in the art:

> The "hypothetical 'person having ordinary skill in the art' to which the claimed subject matter pertains would, of necessity have the capability of understanding the scientific and engineering principles applicable to the pertinent art." (emphasis original)

M.P.E.P. § 2141.03 (citing *Ex parte Hiyamizu*, 10 USPQ2d 1393, 1394 (Bd. Pat. App. & Inter. 1988)).

As discussed, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be *so recognized by persons of ordinary skill.* (citing *M.P.E.P* § 2112) Appellants believe every inventor is a person of ordinary skill with respect to the inventor's own disclosed art. As noted by the Examiner in the Advisory Action, Verhaverbeke et al state "the gas phase etching of small features is facilitated while surface tension effects hamper this in the liquid phase" (col. 1, lines 65-67). Verhaverbeke et al also stated that "organic liquids like *alcohols* . . . results in *fundamental controllability problems of the etching*

process which is not present with carboxylic acids, and especially acetic acids." (col. 4, lines 49-61). (emphasis added). If, as alleged in the Advisory Action, that Appellants' surface tension lowering agent, which includes alcohols (Appellants' pg. 10, lines 14-22) is necessarily present in Verhaverbeke et al such that it would be so recognized by persons of ordinary skill (such as Verhaverbeke et al), then it makes no sense whatsoever for to Verhaverbeke et al to have made the statement disparaging use of alcohols. To conclude otherwise is to allege that Verhaverbeke et al teaching away from the inherent feature. Therefore, Appellants surface tension lowering agent is not an inherent feature.

4.) The Advisory Action's continued reliance on prior errors is objected to.

The Advisory Action cited further reliance on the Office Actions dated September 7, 2005 and April 19, 2006, without comment, as a reason for the non-allowance of the claims. The prior Office actions include a number of mischaracterizations and show an apparent reliance on the Examiner's personal knowledge absent the requested Affidavit. Appellants herein reproduce and incorporate pages 10-13 of Appellants' April 19, 2006 Office Action response.

"No claims are added, amended or canceled; as a result, claims 1, 2, and 4-45 remain pending in this application.

The Office action held:

> With respect to Applicant's arguments on pages 15-17 of the Remarks that Verhaverbeke's acetic acid only serves as catalyst (Verhaverbeke, col. 4, line 34) and not as a surface tension lowing agent or as an etch initiator, it is pointed out that there is no proof that Verhaverbeke's acetic acid only serves as catalyst.

Applicant disagrees with the Office action's characterization of Applicant's prior response. Pages 15-17 of Applicant's response filed on January 25, 2006 recites the Examiner's obligation as provided in the M.P.E.P., and further points out specific instances where the Examiner's burden of prima facie obvious has not been met. Applicant did not point out "that there is no proof that Verhaverbeke's acetic acid only

serves as catalyst." There is, however, no indication in the Verhaverbeke disclosure that acetic acid serves any purpose but what Verhaverbeke has labeled a catalyst.

The Office action further held:

> In the same column, column 4, beginning on line 10, Verhaverbeke discloses that "[A]nhydrous HF hardly etches silicon oxide at room temperature. A catalyst is necessary to start the reaction", effectively teaching that the catalyst, which is an alcohol, a methanol, an acetic acid, and specially carboxylic . . .

Applicant disagrees with the above characterization of the Verhaverbeke et al disclosure. First, the clear language of Verhaverbeke indicates only that H_2O and acetic acid function as a catalyst for anhydrous HF for silicon oxide. (see "A catalysis is needed to start the reaction. Although H_2O can fulfill this role . . . ." col. 4, lns. 10-12). This statement is followed by the statement that "[t]he acetic acid only serves as catalysts (col. 4, ln. 34). Verhaverbeke et al restate this using the language "Acetic acid appears to have a similar catalytic effect on the HF etch process as H_2O because substantial etch rates are achieved." (see col. 5, lns. 4-6). Nowhere else in the Verhaverbeke disclosure but these three instances is a catalyst mentioned. And nowhere in Verhaverbeke et al is Applicant able to find any teaching of an alcohol or a methanol serving as a catalyst.

The Office further held:

> "A catalyst is necessary to start the reaction", effectively teaching that the catalyst . . . is an element of the vapor phase etchant, meeting the claimed limitation "a vapor including an agent" (see definition of "include" . . . (emphasis original)

Applicant disagrees with the characterization of Verhaverbeke and the mischaracterization of Applicant's claimed inventions. First, none of Applicant's claims include the language "a vapor including an agent". Second, none of Applicant's claims include the language "catalyst". Applicant declines to accept the Examiner's definition of element, and further declines to accept the assertion that catalyst and etch initiator are equivalent. A catalyst is something that changes the rate of a chemical reaction without

itself being net consumed in the reaction. A catalyst operates by lowering the activation energy of the reaction. On the other hand, an etch initiator has no such limitations.

The Office further held:

> [S]ince the disclosed material, an alcohol, a methanol, an acetic acid, and specially carboxylic, is the same as the claimed material (for example, claims 2 and 8), the disclosed agent, an alcohol, a methanol, an acetic acid, and specially carboxylic, *could* function as a surface tension lowering agent and *could* be termed a surface tension lowering agent as claimed. (emphasis added)

Applicant disagrees with the characterization. First, because the Office Action is attempting to define a catalyst, in addition to being an etch initiator, which Applicant refuses to accept, as further being equivalent to a surface tension lowering agent. The only instance of "surface tension" in Verhaverbeke et al is disclosed in the background where Verhaverbeke expressly recognize "in the gas phase the etching of small features is facilitated while surface tension effects hamper this in the liquid phase" (col. 1, lns. 65-67). Nowhere in Verhaverbeke et al do they suggest a solution to the problem of surface tension, and nowhere is there any suggestion of a "surface tension lowering agent". In fact, if anything, Verhaverbeke et al appear to teach away from Applicant's claimed inventions given the language pertaining to alcohols stating,

> The acetic acid only serves as catalyst. The etching of SiO_2 by HF generates water on the wafer surface. This water is, together with the acetic acid and the HF . . . must be transported away from the wafer surface by evaporation . . . . For other organic liquids like alcohols, acetone . . . the water is not easily removed from the surface, giving rise to a strong increase in surface water concentration in the course of the etching process. This results in a fundamental controllability problem of the etching process which is not present with carboxylic acids and especially acetic acid. (col. 4, lns. 34-61) (emphasis added)

Where in fact, Verhaverbeke et al expressly disclose that acetic acid and carboxylic acids, in general, are catalysts and that alcohol presents a fundamental problem to surface etching of SiO_2, the Office Action incorrectly asserts "surface tension agent" (such as an alcohol) and catalyst are equivalent. A surface tension lowering agent

may be something that reduces the cohesive forces of molecules between a substance and a surface. With respect to a surface tension lowering agent, the rate of a chemical reaction is generally not relevant, nor is Applicant aware of any requirement that the reaction rate change as a consequence. Further in fact, as outlined above, Verhaverbeke et al disclose an alcohol that appears to function opposite a surface tension lower agent, or at the very least is not desirable. Second, none of Applicant's claims include acetone, so this component is moot.

The Office action's stated that "the disclosed agent, an alcohol, a methanol, an acetic acid, and specially carboxylic *could* function as a surface tension lowering agent and *could* be termed a surface tension lowering agent" is not unsupported anywhere in the language of Verhaverbeke (emphasis added). As such, the Office action assertion appears to be a conclusory statement of a subjective belief. Applicant respectfully traverses the assertion and requests the Examiner provide a reference that describes this assertion. Absent a reference, it appears that the Examiner is using personal knowledge, so the Examiner is respectfully requested to submit an affidavit as required by 37 C.F.R. § 1.104(d)(2).

The Office action further held,

> Furthermore, Verhaverbeke discloses in "Example", col. 5, last paragraph, a reaction chamber equipped with three inlets, one for HF, another for acetic acid. Comparing this setup with the present invention (present invention, Fig. 1), one can hardly see a substantial difference, as far as HF source and surface tension lowering agent (acetic acid) are concerned.

The above conclusory statement appears to be based entirely on a personal and subjective belief not founded in any of the art cited. More particularly, the Office Action here appears to suggest that use of a surface tension lowering agent and a catalyst are equivalent in everyway. Applicant respectfully traverses the assertion and requests the Examiner provide a reference that describes this element. Absent a reference, it appears that the Examiner is using personal knowledge, so the Examiner is respectfully requested to submit an affidavit as required by 37 C.F.R. § 1.104(d)(2).

The Office action further held,

> Furthermore, by Applicant's own admission, the surface tension lowering agent (an alcohol, a methanol, an acetic acid, and specially carboxylic) is approximately 10% of the mixed vapor, approximately 30% of the mixed vapor, or may be a greater or lesser percentage of the mixed vapor (present invention, page 10, lines 19~26). As such, Verhaverbeke's additive element or agent, an alcohol, a methanol, an acetic acid, and specially carboxylic, is fairly termed a surface tension lowering agent.

Applicant respectfully disagrees with the above statement as erroneous. Verhaverbeke et al do not disclose "an alcohol, a methanol, an acetic acid, and specially carboxylic", as a surface tension lowering agent, but rather, as a catalyst. In so holding the Office action is assigning functionality not disclosed by Verhaverbeke and appears to be equating chemical labels with function and use. Applicant, therefore requests the Examiner provide a reference that describes this element. Absent a reference, it appears that the Examiner is using personal knowledge, so the Examiner is respectfully requested to submit an affidavit as required by 37 C.F.R. § 1.104(d)(2)."

E.) Discussion of the rejection of claim 1-2 and 4-37 under 35 U.S.C. § 103(a) as being unpatentable over Shin et al (U.S. 6,385,020) in view of Verhaverbeke et al (U.S. 5,922,624).

CLAIMS 1, 7, 11, 16, 21, 26, AND 31:

Each and every one of Appellants' independent claims 1, 7, 11, 16, 21, 26, and 31 include either a surface tension lowering agent or a surface tension reducing limitation.

1. Shin et al and Verhaverbeke et al, whether alone or in combination, do not teach each and every limitation of Appellants' claimed inventions.

The prior Office actions admitted Shin et al do not teach Appellants' vapor phase etching, and in particular an agent affecting surface tension, but rather, relied on Verhaverbeke et al in combination with Shin et al. However, Verhaverbeke et al also do not teach or suggest, either alone or in combination with Shin et al, each and every limitation of Appellants' claims 1, 7, 11, 16, 21, 26, and 31. For example, neither Shin et al nor Verhaverbeke et al, either alone or in combination, even suggest the problems

addressed in the instant application, such as the need or desirability of reducing surface tension to prevent leaning and/or sticking of memory container structures, let alone offer the solutions provided by Appellants.

Verhaverbeke et al disclose using a mixtures of hydrofluoric acid (HF) and acetic acid for reproducibly etching thick oxide layers. (col. 2, lines 21-29, and lines 36-42). Although use of an admixture of gases or organic solvents was proposed (col. 2, lines 36-42), only HF and acetic acid were actually used, wherein the acetic acid was declared only used as a catalyst. (col. 4, line 4). Appellant was unable to find any use of the proposed organic solvents, let alone an intended function. Moreover, contrary to their initial proposal Verhaverbeke et al later teach that the organic liquids such as alcohols are undesirable for etching oxides. (col. 4, lines 49-60). Nowhere in the Verhaverbeke disclosure is a use of surface tension lowering taught or suggested.

In light of the above, Appellants believe the position taken in the prior Office actions, that Verhaverbeke et al teach vapor phase etching including hydrogen fluoride, a carboxylic and an alcohol as an etch initiator/catalysts that could also function as a surface tension lowering agent, is incorrect. Almost any substance can be alleged to do something. The issue here is whether Verhaverbeke's etch catalyst is inherently a surface tension lowering agent. "Inherent" means "intrinsic", or a natural consequence of something. The intrinsic nature of something is not optional. As discussed, the M.P.E.P. states

> In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." (emphasis in original)

M.P.E.P. § 2112 (citing *Ex parte Levy,* 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)). Therefore, the Examiner's burden is to show the alleged inherent use of the etch catalyst disclosed in Verhaverbeke et al shall also function as a surface tension lowering agent, not one that could also function in such a manner. The presently asserted position, that something might happen, requires Appellants to prove a negative, which is not found within the M.P.E.P. guidelines.

In summary, the Examiner failed to show the alleged inherent feature must necessarily exist in Verhaverbeke et al. Therefore, whether alone or in combination, Shin

et al and Verhaverbeke et al do not teach or suggest each and every limitation of Appellants' claims 1, 7, 11, 16, 21, 26, and 31. And therefore, Appellants' claims 1, 7, 11, 16, 21, 26, and 31 under 35 U.S.C. § 103(a) are patentably distinct from and non-obvious with respect to Shin et al and Verhaverbeke et al.

CLAIMS 2, 4-6, 8-10, 12-15, 17-20, 22-25, AND 27-30:

Claims 2, and 4-6 are dependent on claim 1 and incorporates all its elements, claims 8-10 are dependent on claim 7 and incorporates all its elements, claims 12-15 are dependent on claim 11 and incorporate all its elements, claims 17-20 are dependent on claim 16 and incorporate all its elements, claims 22-25 are dependent on claim 21 and incorporate all its element, and claims 27-30 are dependent on claim 26 and incorporate all its elements. Therefore, Appellants' claims 2, 4-6, 8-10, 12-15, 17-20, 22-25, and 27-30 are distinct from and non-obvious with respect to Shin et al and Verhaverbeke et al for at least the reasons stated above.

2. Verhaverbeke et al teach away from Appellants' claimed inventions, and therefore provide no reasonable expectation of success.

Verhaverbeke et al state

> For other organic liquids like *alcohols*, acetone, the liquid and vapor curves are far apart resulting in a large difference between composition of the liquid and the vapor. Furthermore, for the mentioned materials the shape of the curves is such that the vapor is substantially less water rich than the liquid. Hence the water is not easily removed from the surface, giving rise to a strong increase in surface water concentration in the course of the etching process. This results in a ***fundamental controllability problem*** of the etching process which is *not present with carboxylic acids and especially acetic acid.* (col. 4, lines 49-61) (emphasis added)

Therefore, whereas Appellants' claims include etching with a surface tension *control* agent that includes alcohols, Verhaverbeke et al emphasize the negative consequences of including alcohol to etch control. Those two positions cannot be reconciled. Therefore, Verhaverbeke et al at the very least teach away from Appellants' claimed inventions, and in doing so, also clearly provide no reasonable expectation of success.

F.) Discussion of the rejection of claim 38-45 under 35 U.S.C. § 103(a) as being unpatentable over Shin et al (U.S. 6,385,020) in view of Yang et al (U.S. 6,727,155).

CLAIMS 38 AND 41:

Each and every one of Appellants' independent claims 38 and 41 include a surface tension lowering agent limitation.

1. Shin et al and Yang et al, whether alone or in combination, do not teach each and every limitation of Appellants' claimed inventions.

The prior Office Actions admitted Shin et al do not teach Appellants' vapor phase etching, and in particular an agent affecting surface tension or an etch initiator, but rather, relied on Yang et al in combination with Shin et al. However, Yang et al also do not teach or suggest, either alone or in combination with Shin et al, each and every limitation of Appellants' claims 38-45. In particular, neither Shin et al nor Yang et al, either alone or in combination, even suggest the problems addressed in the instant application, such as the need or desirability of reducing surface tension to prevent leaning and/or sticking of memory container structures, let alone offer the solutions provided by Appellant.

Yang et al disclose vapor wet etching of a rotating substrate that includes a dielectric to form side wall spacers. (col. 4, lines 3-10 and lines 23-26). As with Shin et al, Appellant is unable to find any teaching or suggestion of a surface tension lowering agent, an alcohol or an etch initiator in the Yang et al disclosure. Therefore, whether alone or in combination, Shin et al and Yang et al do not teach or suggest each and every limitation of Appellants' claims 38 and 41. And therefore, Appellants' claims 38 and 41 under 35 U.S.C. § 103(a) are patentably distinct from and non-obvious with respect to Shin et al and Yang et al.

CLAIMS 39-40 AND 42-45:

Claims 39-40 are dependent on claim 38 and incorporates all its elements, and claims 42-45 are dependent on claim 41 and incorporates all its elements. Therefore, Appellants' claims 39-40 and 42-45 are distinct from and non-obvious with respect to Shin et al and Yang et al for at least the reasons stated above.

8. SUMMARY

For at least the reasons stated above, claims 1-2 and 4-37 are not properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Shin et al (U.S. 6,385,020) in view of Verhaverbeke et al (U.S. 5,922,624). Reversal of the rejections of claims 1-2 and 4-37 and allowance of these pending claims are respectfully requested.

For at least the reasons stated above, claims 38-45 are not properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Shin et al (U.S. 6,385,020) in view of in view of Yang et al (U.S. 6,727,155). Reversal of the rejections of claims 38-45 allowance of these pending claims are respectfully requested

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 17th day of October 2006.

KATE GANNON
Name

Signature

CLAIMS APPENDIX

1. A method comprising:

providing a semiconductor substrate that includes a memory container including a double-sided capacitor; and

vapor phase etching a layer adjacent to the a side wall of the memory container with a vapor including a surface tension lowering agent.

2. The method of claim 1, wherein the vapor phase etching comprises vapor phase etching the layer adjacent to the side wall of the memory container with the vapor including a carboxylic.

4. The method of claim 1, wherein the vapor phase etching comprises vapor phase etching an oxide layer adjacent to the side wall of the memory container.

5. The method of claim 1, wherein the vapor phase etching comprises vapor phase etching a borophosphosilicate glass (BPSG) material adjacent to the side wall of the memory container.

6. The method of claim 1, wherein the vapor phase etching comprises vapor phase etching the layer adjacent to the side wall of the memory container with the vapor including hydrogen fluoride and an etch initiator composition.

7. A method comprising:

providing a semiconductor substrate that includes a double-sided capacitor memory container; and

etching a layer adjacent to a side wall of the double-sided capacitor memory container with vapor comprising vapor for reducing surface tension that includes methanol.

8. The method of claim 7, wherein the etching comprises etching an insulator layer adjacent to the side wall of the double-sided capacitor memory container with the vapor comprising vapor for reducing surface tension that includes methanol.

9. The method of claim 7, wherein the etching comprises etching a doped oxide layer adjacent to the side wall of the double-sided capacitor memory container with the vapor comprising vapor for reducing surface tension that includes methanol.

10. The method of claim 7, wherein the etching comprises etching an insulator layer adjacent to the side wall of the double-sided capacitor memory container with the vapor comprising vapor for reducing surface tension that includes hydrogen fluoride.

11. A method of fabricating a semiconductor circuit element, the method comprising:

placing a semiconductor substrate that includes a double-sided capacitor container in a chamber; and

vapor phase etching a layer adjacent to a side wall of the double-sided capacitor container with a vapor that includes hydrogen fluoride, an etch initiator composition and a surface tension lowering composition that includes an alcohol.

12. The method of claim 11, wherein the vapor phase etching comprises vapor phase etching an oxide layer adjacent to the side wall of the double-sided capacitor container with the vapor that includes hydrogen fluoride, the etch initiator composition and the surface tension lowering composition that includes alcohol.

13. The method of claim 11, wherein the vapor phase etching comprises vapor phase etching an insulator layer adjacent to the side wall of the double-sided capacitor container with the vapor that includes hydrogen fluoride, the etch initiator composition and the surface tension lowering composition that includes alcohol.

14. The method of claim 11, wherein the vapor phase etching comprises vapor phase etching a layer adjacent to the side wall of the double-sided capacitor container with the

vapor that includes hydrogen fluoride, the etch initiator composition and the surface tension lowering composition that includes methanol.

15. The method of claim 11, wherein the vapor phase etching comprises vapor phase etching a layer adjacent to the side wall of the double-sided capacitor container with the vapor that includes hydrogen fluoride, H_2O and the surface tension lowering composition that includes isopropyl alcohol.

16. A method of fabricating an integrated circuit, the method comprising:

housing the integrated circuit in a vapor etch chamber; and

vapor phase etching an insulator layer formed adjacent to a double-sided capacitor container in the integrated circuit with a vapor including a surface tension lowering agent, wherein the vapor phase etching of the insulator layer comprises inserting a vapor comprised of a hydrogen fluoride and isopropyl alcohol into the vapor etch chamber.

17. The method of claim 16, further comprising heating the hydrogen fluoride and the isopropyl alcohol prior to inserting the vapor into the vapor etch chamber.

18. The method of claim 16, wherein the vapor phase etching comprises vapor phase etching a doped oxide layer formed adjacent to the double-sided capacitor container in the integrated circuit.

19. The method of claim 16, wherein the vapor phase etching comprises vapor phase etching a borophosphosilicate glass (BPSG) layer formed adjacent to the double-sided capacitor container in the integrated circuit.

20. The method of claim 16, wherein the inserting the vapor comprises inserting the vapor comprised of hydrogen fluoride, isopropyl alcohol and an etch initiator composition into the vapor etch chamber.

21. A method comprising:

placing a substrate that includes an array of memory into a chamber, the array of memory having at least one memory container with a side wall with an embedded capacitor; and

vapor phase etching of a layer of an insulator material formed adjacent to the side wall, wherein the vapor phase etching comprises:

mixing a hydrogen fluoride with a vapor including a surface tension lowering agent including isopropyl alcohol to form a mixed vapor; and

inserting the mixed vapor into the chamber.

22. The method of claim 21, further comprising heating the hydrogen fluoride and the isopropyl alcohol prior to inserting the mixed vapor into the vapor etch chamber.

23. The method of claim 21, wherein the mixing comprises mixing the hydrogen fluoride, the isopropyl alcohol and an etch initiator composition to form the mixed vapor.

24. The method of claim 21, wherein the vapor phase etching comprises vapor phase etching of a layer of oxide formed adjacent to the side wall.

25. The method of claim 21, wherein the vapor phase etching comprises vapor phase etching of a layer of silicon dioxide formed adjacent to the side wall.

26. A method for fabricating a semiconductor substrate, the method comprising:

placing the semiconductor substrate that includes a memory container into a vapor etching chamber, wherein a side wall of the memory container includes a double-sided capacitor; and

vapor phase etching of a layer of an insulator material formed adjacent to the side wall of the memory container, wherein the vapor phase etching comprises:

mixing an etch initiator composition and surface tension reducing composition including hydrogen fluoride and alcohol to form a mixed vapor;

heating the mixed vapor; and

inserting the mixed vapor into the vapor etching chamber.

27. The method of claim 26, wherein the mixing comprises mixing the etch initiator composition and the surface tension reducing composition including hydrogen fluoride and methanol to form the mixed vapor.

28. The method of claim 26, wherein the mixing comprises mixing the etch initiator composition and the surface tension reducing composition including hydrogen fluoride and isopropyl alcohol to form the mixed vapor

29. The method of claim 26, wherein the vapor phase etching comprises vapor phase etching of a layer of silicon nitride formed adjacent to the side wall of the memory container.

30. The method of claim 26, wherein the vapor phase etching comprises vapor phase etching of a layer of silicon oxynitride formed adjacent to the side wall of the memory container.

31. A method comprising:

placing a semiconductor substrate into a chamber; and

vapor phase etching of an insulator material formed adjacent to a double-sided container on a semiconductor substrate, wherein the vapor phase etching comprises:

forming a vapor that includes an H_2O vapor, an HF gas and a surface tension lowering agent; and

inserting the vapor into the chamber.

32. The method of claim 31, wherein the forming comprises forming the vapor that includes H_2O, hydrogen fluoride and carboxylic.

33. The method of claim 31, wherein the forming comprises forming the vapor that includes H_2O, hydrogen fluoride and alcohol.

34. The method of claim 31, wherein the forming comprises forming the vapor that includes H_2O, hydrogen fluoride and isopropyl alcohol.

35. The method of claim 31, wherein the forming comprises forming the vapor that includes H_2O, hydrogen fluoride and methanol.

36. The method of claim 31, wherein the vapor phase etching comprises vapor phase etching of a silicon dioxide material formed adjacent to the double-sided container on the semiconductor substrate.

37. The method of claim 31, wherein the vapor phase etching comprises vapor phase etching of a doped oxide material formed adjacent to the double-sided container on the semiconductor substrate.

38. A method for fabricating a memory array, the method comprising:

forming at least one memory container in a borophosphosilicate glass (BPSG) material on a substrate, wherein a side wall of the at least one memory container includes a double-sided capacitor; and

removing at least a part of the BPSG material based on a vapor wet etch operation with a vapor including a surface tension lowering agent comprising hydrogen fluoride and alcohol.

39. The method of claim 38, wherein the removing comprises removing the at least a part of the BPSG material based on the vapor wet etch operation with the vapor including a surface tension lowering agent comprising hydrogen fluoride and isopropyl alcohol.

40. The method of claim 38, wherein the removing comprises removing the at least a part of the BPSG material based on the vapor wet etch operation with the vapor including a surface tension lowering agent comprising hydrogen fluoride and methanol.

41. A method comprising:

forming at least one memory container in an oxide, wherein a side wall of the at least one memory container includes a double-sided capacitor; and

vapor wet etching of a layer of the oxide with a vapor comprised of hydrogen fluoride, an etch initiator composition and a surface tension lowering agent.

42. The method of claim 41, wherein the forming the at least one memory container comprises forming the at least one memory container in silicon oxide.

43. The method of claim 41, wherein the vapor wet etching comprises vapor wet etching with a vapor comprised of hydrogen fluoride, the etch initiator composition and an alcohol.

44. The method of claim 41, wherein the vapor wet etching comprises vapor wet etching with a vapor comprised of hydrogen fluoride, the etch initiator composition and isopropyl alcohol.

45. The method of claim 41, wherein the vapor wet etching comprises vapor wet etching with a vapor comprised of hydrogen fluoride, the etch initiator composition and methanol.

EVIDENCE APPENDIX

Exhibit A: Solid Surface Tension: The Equation of State Approach and the Theory of Surface Tension Components. Theoretical and Conceptual Considerations

RELATED PROCEEDINGS APPENDIX

None.

Exhibit A

Langmuir 1987, *3*, 588–591

Solid Surface Tension: The Equation of State Approach and the Theory of Surface Tension Components. Theoretical and Conceptual Considerations

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This paper considers the reasons for the apparent failure of the surface tension component theory as first proposed by Fowkes. This failure was illustrated in a previous paper, in which we showed that two liquids of the same surface tension always have the same contact angle on a given solid surface, irrespective of the intermolecular forces that are operative. It turns out that the key point is the thermodynamically proven existence of an equation of state for interfacial tensions which guarantees that $\gamma_{SL} = f(\gamma_{SV},\gamma_{LV})$. With this restriction, there is no room in Young's equation to accommodate a direct dependence of contact angles on dispersion, polar, or hydrogen-bonding forces. Thus, while surface tension components such as γ^d and γ^p might well exist, they cannot be determined from contact angles. It is shown that quantities which are at present claimed to be "dispersion" or "polar" components of surface tension are merely artifacts of the Rayleigh–Good equation and do not have the meaning commonly ascribed to them.

Introduction

In a previous publication[1] we have shown that the contact angles of two liquids on a single solid surface are equal when the surface tensions of the liquids are the same, regardless of the relative magnitudes of the dispersion forces within each of the two liquids. These results cast into doubt both the legitimacy and the necessity of dividing surface tensions into components in order to predict solid and solid–liquid interfacial tensions.[2] On the other hand, these same contact angle data clearly support the equation of state approach,[3] whereby the solid–liquid interfacial tension is thought to be a function only of the total solid and liquid surface tensions, irrespective of the types and relative magnitudes of the intermolecular forces present within each phase.

Thus, as far as the determination of solid surface tensions from contact angles is concerned, one might well discard the approach of surface tension components altogether in favor of an equation of state approach. Nevertheless, there are three points which merit further consideration. First, the preceding paper[1] does not consider hydrogen-bonding liquids, and proponents of the Fowkes approach might argue that the contact angle of hydrogen-bonding liquids may not follow the same pattern. While it is possible to perform such measurements, the purpose of this paper is to consider theoretical aspects of the problem relevant to this question. Second, there is the question of whether the apparent breakdown of the Fowkes approach in the preceding paper[1] could have been predicted and exactly where the fallacy in Fowkes' arguments is. Finally, what is the correct interpretation of the quantities known as "dispersion components of the interfacial tension"?

These questions are best approached from an historical perspective.

Historical Perspective

The calculation of solid surface tension, γ_{SV}, from the contact angle, θ, of a liquid of surface tension γ_{LV}, starts with Young's equation

$$\gamma_{SL} = \gamma_{SV} - \gamma_{LV} \cos \theta \qquad (1)$$

Table I. Solid Surface Tension (mJ/m²) of *n*-Hexatriacontane at 20 °C[a]

liquid	γ_{LV}	θ	γ_S	γ_S^{ES}
water	72.8	104.6	10.2	19.8
glycerol	63.4	95.4	13.0	20.0
thiodiglycol	54.0	86.3	15.3	19.8
ethylene glycol	47.7	79.2	16.8	19.8
hexadecane	27.6	46	19.8	20.1
tetradecane	26.7	41	20.6	20.7
dodecane	25.4	38	20.3	20.4
decane	23.9	28	21.2	21.2
nonane	22.9	25	20.8	20.8

[a] γ_S calculated by using eq 4 and γ_S^{ES} calculated with the equation of state of Neumann et al.[5] Contact angle data (deg) from ref 12.

where γ_{SL} is the solid–liquid interfacial tension. Of the four quantities in Young's equation, γ_{LV} and θ are readily measurable. Thus, in order to determine γ_{SV}, further information is necessary. Consequently, one obvious approach is to seek one more relation between the parameters in eq 1, such as an equation of state possibly of the form

$$\gamma_{SL} = f(\gamma_{LV},\gamma_{SV}) \qquad (2)$$

The simultaneous solution of eq 1 and 2 would solve the problem. Note that if the commonly used assumption of negligible liquid vapor adsorption is applied, then eq 1 and 2 may be written in terms of γ_L and γ_S, rather than of γ_{LV} and γ_{SV}.

An old equation of state for solid–liquid interfacial tensions is that due to Rayleigh and later Good et al. (see review in ref 4)

$$\gamma_{SL} = \gamma_S + \gamma_L - 2(\gamma_S\gamma_L)^{1/2} \qquad (3)$$

where γ_S is the solid surface tension (equal to γ_{SV} if adsorption is neglected) and γ_L (or equivalently γ_{LV}) is the surface tension of the liquid. Combining eq 3 with 1 gives

$$\gamma_S = \tfrac{1}{4}\gamma_L(1 + \cos \theta)^2 \qquad (4)$$

Early investigations by Good et al.[4] showed that eq 4 yields consistent values of γ_S when γ_S and γ_L are both relatively small (for example, liquid alkanes on Teflon or paraffin wax). Contact angle data for liquids of higher surface tension, however, lead to values of solid surface

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